AMENDMENTS TO THE DRAWINGS

The attached drawing sheets include a sheet making a change to the lone figure originally filed and replacing the original sheet containing that figure, as well as a sheet containing two new figures.

In the lone original figure, the legend has been changed to label the figure "Fig. 3." The two new figures illustrate features of Applicant's invention described in the specification as filed but previously not claimed or depicted in the drawings.

Attachments: Replacement Sheet
Annotated Sheet Showing Changes
New Sheet

REMARKS

Summary of Amendments and Status of Claims

Independent claims 1 and 2 have been amended to establish all the more clearly the metes and bounds of the subject matter Applicants regard as their invention.

Dependent claims 13 and 14 have been canceled.

With claims 3 and 5 having been withdrawn, and claims 4 and 6-10 having been earlier canceled,

- **claims 1, 2, 11 and 12 are pending.**

Support for New Amendments to Claims 1 and 2

A studied reading of the "Detailed Description of the Invention" section of the present specification clearly indicates that the device-forming film is epitaxially grown *directly* onto the mirrorlike, planar surface of the GaN substrate, and that as a result, the superficial metal contamination, minimized to within the range recited in claims 1 and 2, on the substrate must be present at the *interface* between it and the device-forming film.

Support accordingly may be found: in paragraph [0038], which notes that the present invention is directed to the manufacture of "mirrorlike-finish GaN wafers with minimal metal contamination and possessing smooth, flat surfaces"; in paragraph [0045] where that paragraph explains that the epi-grown GaN or InGaN films are "atop the surface" of the substrate; and in the description under "Photoluminescence Assay," in paragraph [0134] in particular, which makes clear that the contamination was assayed *after* a GaN layer was "deposited to a 2 μm layer thickness onto the undoped GaN substrates" prepared as described in the immediately preceding Experimental Examples 1 through 5 of the specification, and then a 0.2 μm InGaN layer was deposited onto the GaN layer. (Although, as noted in paragraph [0133], electrodes were not then added to make actually operational devices for the assay, the layers were nonetheless device-forming.)

Finally, paragraph [0136] notes, "The InGaN formed atop [the GaN substrate] is low dislocation density, high-quality crystal[, which] signifies that the surface of the GaN substrate that is the film's base, [is] smooth and without metal contamination" (where it will be appreciated that "without" is a relative term, meaning, as set forth clearly in the experimental examples, 10^{12} atoms/cm^2 or less). It is thus clear that the PL assay characterized contamination present on the GaN substrate, but was carried out by lasing the substrates *through* the device-forming layers. Hence, on a GaN substrate according to the present invention, the metal contamination present prior to

deposition of the device-forming GaN and InGaN layers onto the substrate resultantly must exist at the *interface* between the substrate and the GaN layer deposited onto the substrate for the PL assay.

Specification

The specification has been amended to accord with the revisions made in the drawings. In particular, the brief description of the drawings has been amended to introduce two new figures that have been added to comply with the Office's requirement to show all features set forth in the claims, while in the detailed description of the invention, instances where the features now illustrated in the new figures are described have been amended to refer to the corresponding depiction.

Drawings

A new drawing sheet attached to this paper corrects the drawings so as to "show every feature of the invention specified in the claims," as required by the Examiner. In addition, a replacement sheet, also attached to this paper, for the sheet containing the lone figure originally filed now numbers that figure, sequentially in accordance with the two new figures that have been added.

No new matter has been added. Among the features that the Examiner required be shown in the corrected drawings, the Examiner included the feature, recited in claims 13 and 14, that "the device-forming epitaxial film has been grown only on the faces in which Ga is exposed." Nevertheless, inasmuch as claims 13 and 14 have by the present amendment been canceled, the feature that the device-forming film is grown *only* on the faces in which Ga is exposed has not been illustrated in the presently corrected drawings.

Claim Rejections – 35 U.S.C. § 112

Claims 13 and 14 were rejected under 35 U.S.C. § 112, first and second paragraphs.

Not acquiescing in the propriety of these rejections, Applicants have canceled claims 13 and 14 without prejudice, rendering the rejections under the § 112-based part of the Office action moot.

Claim Rejections – 35 U.S.C. § 103

Claims 1, 2, 11 and 12: Wilk et al. '660 in view of Freeouf et al. '829, and Yang et al. '810 further in view of Motoki et al. '347

Claims 1, 2, 11 and 12 stand rejected as being unpatentable over U.S. Pat. App. Pub. No. 2004/0067660 in the name of Wilk et al., in view of U.S. Pat. No. 5,508,829 to Freeouf et al., and U.S. Pat. App. Pub. No. 2004/0149810 in the name of Yang et al., and now further in view of U.S. Pat. App. No. 6,468,347 to Motoki et al.

The § 103 rejections are a verbatim repetition of the § 103 rejections from the June 23, 2009 Office action, except that *Motoki et al.* has been additionally cited to address, in two paragraphs appearing at the bottom of page 6 and the top of page 7 of the December 23, 2009 Office-action report, the "mirrorlike, planar surface" feature recited in claims 1 and 2. Addressing what is new in the December 23, 2009 Office action report—that is, the "Response to Arguments" appearing at the head of the "Detailed Action"—will serve to address the present § 103 rejections with respect to claims 1 and 2.

Early in the Response to Arguments, the Office alleges, "Whether *Wilk et al.* concerns LEDs or not is irrelevant to the argument." Even granting that whether *Wilk et al.* concerns LEDs might not be relevant to the Office's counterarguments, whether *Wilk et al.* concerns LEDs *is* relevant to Applicants' original arguments. That is, in the remarks accompanying their amendment of September 23, 2009, Applicants argued that LED formation demands a higher level of planarity and cleanness from substrates than FET formation does. As noted at the bottom of Page 7 of the September 23 reply,

> It must be concluded that *Wilk et al.* is not concerned with polishing III-V substrates to a mirrorlike, planar finish because *Wilk et al.* is only concerned with transistor formation, not light-emitting device formation. That is, a person skilled in the art would readily understand that semiconductor substrates for forming transistors do not require the degree of planarity that semiconductor substrates for forming light-emitting devices require.

And at the top of Page 8 of the September 23 reply, Applicants noted

> The present invention involves a gallium nitride substrate that has been polished to a mirrorlike, planar finish. Indeed, the thrust of the present invention is coping with the process-transformed layer left by the polishing operation. In sharp contrast to *Wilk et al.*, then, the present invention as set forth in claims 1 and 2 of the present application is "[a] gallium-nitride semiconductor substrate <u>having a mirrorlike, planar surface</u> onto which a light-emitting-device-forming film has been epitaxially grown."

At II. on Page 8 of Applicants' September 23, 2009 reply, Applicants' arguments against the applicability of *Wilk et al*. in view of *Freeouf et al*. were based on the grounds that: i) traps are defects/dislocations that capture charge carriers; ii) pinning is impurities causing defects/dislocations to become traps; iii) the density level in *Wilk et al*. is of traps; iv) *Freeouf et al*. teaches inclusions ("metallic precipitates") deliberately incorporated into GaAs to function as charge-carrier traps.

Now it is respectfully submitted that a person skilled in the art contemplating the two references would not regard the metallic precipitates deliberately incorporated as charge-carrier traps into GaAs, according to the teachings of *Freeouf et al*., to be tantamount to pinned-defects-as-traps according to the teachings of *Wilk et al*. The traps of *Wilk et al*. are defects/dislocations in GaN that are made into traps (i.e., that are "pinned") by the neighboring presence of impurities, as noted in Applicants' September 23, 2009 remarks; the traps of *Freeouf et al*. are metallic inclusions deliberately precipitated into GaAs.

Nevertheless, the Office asserts, near the bottom of Page 2 of the December 23, 2009 action report, under Response to Arguments, "It is clear that the charge traps can be defined as 'contaminants' as disclosed by *Wilk et al*. (i.e., then what is 'contamination'?)."

In answer, it is respectfully submitted that contamination according to claims 1 and 2 of the present application is neither the pinned defects/dislocations of *Wilk et al*. nor the precipitated metallic inclusions of *Freeouf et al*., but rather is "one or more elements selected from Si, Cr, Mn, Fe, Ni, Cu, Zn and Al at a density level of from 15 × 10^{10} to 10 [or 5, in claim 2] × 10^{11} atoms/cm^2," which are "at the interface between the mirrorlike, planar surface" of the GaN substrate "and the device-forming film grown thereon."

The Office's assertion near the bottom of Page 2 of the December 23, 2009 action report continues, "Furthermore, *Freeouf et al*. is simply utilized to demonstrate how a charge trap could also be chromium." If the Office is seeking simply to demonstrate prior-art disclosure of metalloid impurities in III-V crystal, then surely any number of references in the crystallographic art could be cited.

Yet to do so would be hardly relevant to making a *prima facie* case of any alleged obviousness of claims 1 and 2 of the instant application, for the very same reasons that *Wilk et al*. even in combination with *Freeouf et al*. fails to meet the claim 1 and 2 limitations that these references are alleged to demonstrate. As argued in the fourth paragraph on Page 9 of Applicants' September 23, 2009 reply

> Moreover, even if the Cr inclusions of *Freeouf et al*. could be said to be tantamount to *Wilk et al*.'s pinned-defects-as-traps, . . . such inclusions nonetheless would not in any way be tantamount to the metal contaminants that the present invention is concerned with

—namely, "one or more elements selected from Si, Cr, Mn, Fe, Ni, Cu, Zn and Al at a density level of from 15 × 10^{10} to 10 [or 5, in claim 2] × 10^{11} atoms/cm^2," which are "at

the interface between the mirrorlike, planar surface" of the GaN substrate "and the device-forming film grown thereon."

For at least the foregoing reasons, it is respectfully submitted that the cited references, *Wilk et al*. in combination with *Yang et al*., *Freeouf et al*. and further, *Motoki et al*., do not meet the limitations of claims 1 and 2. Claims 1 and 2 being patentably distinct from the cited combination of references, it follows that their respective dependent claims 11 and 12 are patentably distinct as well.

Conclusion

Applicants having herewith made a proper Request for Continued Examination, in light of the present amendments and arguments, full reconsideration, and withdrawal, of the rejections is courteously urged. Favorable action by the Examiner passing this application to allowance at an early date is solicited.

Respectfully submitted,

March 23, 2010 /James Judge/

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